

**DATA STRUCTURE AND RDBMS
(CSEN 3206)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
 - (i) Which of the following is Correct with respect to a stack?

(a) push(pop())	(b) pop(pop())
(c) push(push(x))	(d) pop(push(x)).
 - (ii) Consider an implementation of unsorted singly linked list. Suppose it has its representation with a head pointer only. Given the representation, which of the following operation can be implemented in $O(1)$ time?
 - I) Insertion at the front of the linked list
 - II) Insertion at the end of the linked list
 - III) Deletion of the front node of the linked list
 - IV) Deletion of the last node of the linked list

(a) I and II (b) I and III (c) I, II and III (d) I, II and IV.
 - (iii) What must be the ideal size of array if the height of tree is 'l'?

(a) 2^{l-1} (b) $l-1$ (c) l (d) $2l$.
 - (iv) Transform the following infix expression to postfix form

$$(A + B) * (C - D) / E$$

(a) $A B * C + D / -$	(b) $A B C * C D / - +$
(c) $A B + C D * - / E$	(d) $A B + C D - * E /$
 - (v) Four DML commands are

(a) Create, Update, Delete, Select	(b) Insert, Update, Drop, Select
(c) Create, Alter, Delete, Select	(d) Insert, Modify, Delete, Select.
 - (vi) Cardinality ratio means
 - (a) number of attributes associated with an entity
 - (b) number of entities related with other entities via a relationship
 - (c) number of entities in an entity set
 - (d) ratio of number of columns and rows in a table.

- (vii) In relational model, degree of a relation is

(a) number of rows	(b) number of key attributes
(c) number of attributes	(d) number of entities.
- (viii) For a relation $R = \{ J, K, L \}$ with functional dependencies $F = \{ JK \rightarrow L ; L \rightarrow K \}$ the candidate keys are

(a) both J and K	(b) JK	(c) only J	(d) JK and JL.
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- (ix) The entity integrity constraint states that
 - (a) no primary key value can be null
 - (b) a part of the key may be null
 - (c) duplicate object values are allowed
 - (d) none of these.
- (x) Which of the following operations is used if we are interested in only certain columns of a table?

(a) PROJECTION	(b) SELECTION
(c) UNION	(d) JOIN.

Group - B

2. (a) Write an algorithm or pseudo-code to evaluate postfix expression using stack. Use it to evaluate: $4 3 2 * + 9 -$
Write all intermediate steps.
- (b) A singly-linked list contains integer data. Write an algorithm or a pseudo-code to delete the node containing maximum value.
- (c) In case of a Linked List which method of searching is more suitable?
(3 + 3) + 5 + 1 = 12
3. (a) State the disadvantages of linked list implementation of stack.
- (b) Consider the following operations in Circular Queue
 - (i) insert the following values 40, 30, 23, 7, 67
 - (ii) delete 40, 30, 23
 - (iii) insert 80, 75, 11

The Circular Queue can accommodate a maximum of five elements. *Front* and *Rear* are set to zero at beginning. What will be the *Front* and *Rear* values after every operation?
- (c) Write down an algorithm to implement Quick Sort on a set of n numbers.
2 + 5 + 5 = 12

Group - C

4. (a) What are the relative merits and demerits of Recursion and Iteration?

- (b) How the factorial function can be evaluated by recursive and iterative manner? Explain with an example as factorial (5).
- (c) Why tail recursion is needed?

$$4 + (2 + 4) + 2 = 12$$

5. (a) Construct a binary search tree whose nodes in inorder and preorder are given as follows (Show all intermediate steps):

Inorder : X P H S M I R J Y G Preorder: M P X S H Y R I J G

- (b) Write Algorithm /pseudo code for Binary search on an n element array.
- (c) Convert the following infix expression into its equivalent postfix expression (Show all intermediate steps):

$$A*(B-C)/D+E/(F+G*H)$$

$$5 + 3 + 4 = 12$$

Group - D

6. (a) Explain and differentiate between logical Data Independence and Physical Data Independence with the help of examples. You may provide a diagram to illustrate your answer.

- (b) Differentiate between the following:

- Composite attribute v/s Multivalued Attribute
- Complex Key v/s Candidate Key

- (c) Suppose you are given the following requirements for a simple database for the Indian Premier League (IPL):

- The IPL has many *teams*; each team is identified by its name.
- Each *team* has a *name*, a *city*, a *coach*, a *captain*, and a *set of players*.
- Each *player* belongs to only one *team*.
- Each player may be identified by his *player_id*.
- Each *player* has a *name*, a *specialization* (such as *batsman*, *bowler*, *keeper*, *all-rounder* etc.), and a *base price*.
- Each player also has *injury records* consisting of *type* and *description*.
- A team captain is also a player. One team has only one captain.
- A *game* is played between two teams (referred to as *host team* and *guest team*)
- Each *game* has a *date* (such as Apr 23rd, 2017) and a *result* (such as KKR beat RCB).

Construct a clean and concise ER diagram for the IPL database clearly depicting each entity, required attributes, degree and cardinality of the relationships. Take care of any *weak entities*, *recursive relationships*, and *role names* if such are present.

$$4 + 2 + 6 = 12$$

7. (a) Given the following relations, where keys are generally underlined:
EMPS (ADHAAR, name, address, zip, phone, deptno, jobTitle, salary)

CSZ (zip, city, state)

DEPTS (deptno, deptName, deptMgrADHAAR)

TRIPS (TripId, DestinationCity, DepartureDate, ReturnDate, ADHAAR)

EXPENSES (TripId, Item, Date, Amount)

Find all the foreign keys, highlight them by drawing proper arrows.

- (b) Write relational algebra expressions for the following:

- List *employee names* from the "Accounts" department whose *salary* is more than 30000.
- List all the *expense items*, *dates*, *amounts* and *destination city* for employee "Ramesh Shah".

- (c) Find Primary Key (s) for TRIPS and EXPENSES.

- (d) Write SQL for the following

- List *employee names* who have travelled to "Mumbai" during "March 2018".
- List all *names* and *phones* of people who earn more than 500000 in salary.

$$3 + 4 + 1 + 4 = 12$$

Group - E

8. (a) Discuss the various Update Anomalies in case of normalization.

- (b) Consider the following relation: R (M, Y, P, MP, C) with the following dependencies:

$$F = \{M \rightarrow MP; M, Y \rightarrow P; MP \rightarrow C\}$$

Find the Candidate Key(s) of R.

Find the partial dependencies and transitive dependencies (if any) and hence decide the normal form of R with respect to the set of functional dependencies F.

- (c) Define BCNF. How does it differ from 3NF?

$$3 + (2 + 5) + 2 = 12$$

9. (a) Define Isolation and Durability properties of a transaction in DBMS. Give examples for both.

- (b) What is a recoverableschedule and a non-recoverableschedule. Give example of both.

- (c) Let T1, T2 and T3 be transactions that operate on the same data items A, B and C. Let

r1(A) mean that T1 reads A

w1(A) means that T1 writes A

Consider the following schedule:

S: *r1(X)*; *r2(Z)*; *r1(Z)*; *r3(X)*; *r3(Y)*; *w1(X)*; *w3(Y)*; *r2(Y)*; *w2(Z)*; *w2(Y)*;

By using a PrecedenceGraph, find out if the given schedule is ConflictSerializable or not. If so, then write the Serializable schedule.

$$3 + 3 + 6 = 12$$